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OBLON SPIVAK MCCLELLAND MAIER & NEUSTADT PC  
FOURTH FLOOR  
1755 JEFFERSON DAVIS HIGHWAY  
ARLINGTON, VA 22202

EXAMINER

DICKEY, THOMAS L

ART UNIT

PAPER NUMBER

2826

DATE MAILED: 05/06/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.

09/340,720

Applicant(s)

TAKASHIMA ET AL.

Examiner

Thomas L Dickey

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 15 February 2002.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 1-12 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-12 is/are rejected.
- 7) ☒ Claim(s) 1 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.  
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

## Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some \* c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

## Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_\_
- 4) ☐ Interview Summary (PTO-413) Paper No(s) \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

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## DETAILED ACTION

1. The amendment filed on 02/15/02 has been entered.

### *Claim Rejections - 35 USC § 102*

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless --

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

Claims 1,2, and 4-9 are rejected under 35 U.S.C. 102(e) as being anticipated by KRIVOKAPIC et al. (6,100,598).

Krivokapic et al. discloses a MOSFET having high and low dielectric materials wherein a channel (no part #) of a first conductive type formed on a surface layer of a semiconductor substrate 12, a source 34 and a drain 34 of a second conductive type formed on both sides of the channel, a gate insulation film 210 with a first relative permittivity formed at least on the channel directly or through buffer insulation film 40, a gate electrode 220 formed on the gate insulation film 210, a side insulation film 194 (alternatively 196) formed at least on a side of the gate insulation film and having a second relative permittivity which is smaller than the first relative permittivity, wherein an area of the gate insulation film 210 adjacent to the interface between the gate insulation

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film 210 and the gate electrode 220 is larger than an area thereof which is adjacent to the interface between the gate insulation film 210 and the channel, wherein the first gate insulation film 210 is a high dielectric film or a ferroelectric film including a composition or an element of one of  $Ta_2O_5$ ,  $Sr_2Ta_2O_7$ ,  $TiO_2$ ,  $SrTiO_3$ ,  $BaTiO_3$ ,  $CaTiO_3$ ,  $Ba_xSr_{1-x}TiO_3$ ,  $PbTiO_3$ ,  $PbZr_xTi_{1-x}O_3$ ,  $SrBi_2Ta_2O_9$ ,  $SrBi_2(Ta_xNb_{1-x})_2O_9$ , or  $Bi_2(Ta_xNb_{1-x})O_6$ , namely  $TiO_2$  or  $SrTiO_3$ , so that the first permittivity is 20 or more, the width of the gate insulation film 210 on the channel side is smaller than the width of the gate insulation film on the gate electrode 220 side in a length along a channel width direction of the gate insulation film 220, a sectional shape of the gate insulation film 210 along a direction of the source-drain is one of tapered shape, a trapezoid, a sector, and a stair, namely, a rectangle (i.e. a type of trapezoid) a sectional shape along a direction of the source-drain of the gate insulation film 210 from the gate electrode to a predetermined line (claim reads "the predetermined distance") on the channel side is a rectangle, and the just mentioned sectional shape is one of a tapered shape, a trapezoid, a sector, and a stair, namely, a rectangle (i.e. a type of trapezoid), the buffer insulation film includes one of  $SiO_2$ ,  $Si_3N_4$ ,  $NO$ ,  $TiO_2$ ,  $SrTiO_3$ ,  $MgO$  or  $CeO_2$ , namely,  $SiO_2$  or  $Si_3N_4$ . Note col. 8, lines 5 and 8, and figure 20 of Krivokapic et al. Further, Krivokapic et al. discloses that an area of a bottom part of said gate electrode 220 in contact with the gate insulation film 210 is larger than an area of an upper part of said gate insulation film 210. Note figure 20 of Krivokapic et al.

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***Claim Rejections - 35 USC § 103***

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 3, 10 and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over KRIVOKAPIC et al. (6,100,598).

With regard to claim 3, Krivokapic et al. discloses all the elements of claim 3 except that area (S1, per claim) of the gate insulation film 210 adjacent to the interface between the gate insulation film 210 and the gate electrode 220 is 1.5 times larger than an area (S2, per claim) thereof which is adjacent to the interface between the gate insulation film 210 and the channel. Although Krivokapic et al.'s device does not teach the exact ratio of areas as that claimed by Applicant, the width differences are considered obvious design choices and are not patentable unless unobvious or unexpected results are obtained from these changes. It appears that these changes produce no functional differences and therefore would have been obvious. Note *In re* Leshin, 125 USPQ 416.

With regard to claims 10 and 11, these claims require a first plurality of devices, individual ones of said first plurality of devices described in a manner identical to devices described in claim 1 and also by Krivokapic et al., and a second plurality of

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devices, individual ones of said second plurality of devices being identical in all but one respect to individual ones of said first plurality of devices, said individual ones of said second plurality of devices likewise described in a manner identical to devices described in claim 1 and also by Krivokapic et al. There is the additional limitation that top/bottom ratios of gate insulation films in single ones of the first plurality of devices be greater than top/bottom ratios of gate insulation films in single ones of the second plurality of devices. As claimed, individual ones of the first and second pluralities are otherwise identical. It is considered that it would have been obvious to a person having skill in the art to reproduce a given plurality of Krivokapic et al.'s MOSFET HAVING HIGH AND LOW DIELECTRIC MATERIALS in order to provide a plurality of devices with lower gate capacitances to thus densely pack a large number (at least two pluralities) of such devices on one chip. Given at least some manufacturing tolerance in top/bottom ratios of gate insulation films in these devices, a first sub-plurality of said given plurality will have larger than average top/bottom ratios of gate insulation films, a second sub-plurality will have smaller than average top/bottom ratios of gate insulation films, and individual ones of the larger than average devices will be larger than individual ones of the smaller than average devices. It should be noted that claims 10 and 11 require that the 1<sup>st</sup> and 2<sup>nd</sup> pluralities be present but not that they be sorted out or arranged in any way.

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***Allowable Subject Matter***

Claim 12 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims, because none of these references disclosed or can be combined to yield the claimed invention such as A semiconductor device comprising: a plurality of first MOS transistors, each of said first MOS transistors including a first channel of a first conductivity type formed on a surface layer of a semiconductor substrate, a first source and a first drain of a second conductivity type formed to both sides of said first channel, a first gate insulation film with a first relative permittivity formed at least on the first channel directly or through a buffer insulation film, a first gate electrode formed on said first gate insulation film, and a first side insulation film formed at least on side of said first gate insulation film and having a second relative permittivity which is smaller than the first relative permittivity; and a plurality of second MOS transistors, each of said second MOS transistors including, a second channel of the first conductivity type formed on a surface layer of said substrate, a second source and a second drain of the second conductivity type formed on both sides of said second channel, a second gate insulation film with the first relative permittivity formed at least on said second channel directly or through a buffer insulation film, a second gate electrode formed on said second gate insulation film, and a second side insulation film formed at least on side of said second gate insulation film and having said second relative permittivity, wherein, when a cross-section on a side of said first channel S 1, a

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cross-section on a side of said first gate electrode is S2, a cross-section on a side of said second channel S3, and a cross-section on a side of said second gate insulation film is S4, a condition of:  $S2/S1 > S4/S3$  is satisfied, and an area of a bottom part of said first gate electrode in contact with the first gate insulation film is larger than an area of an upper part of said first gate insulation film, and an area of a bottom part of said second gate electrode in contact with the second gate insulation film is larger than an area of an upper part of said second gate insulation film, and wherein a voltage applied to the first gate electrode is lower than a voltage applied to the second gate electrode as recited in claim 12.

### ***Response to Arguments***

4. Applicant's arguments filed 02/15/02 have been fully considered but they are not persuasive.

It is argued, at page 5 of the remarks, that "With this configuration, not only the channel region(s) of the semiconductor devices defined in claims 1, 9, and 10, but also the source, drain, element isolation, and gate contacting regions can be widened as well." However, it is noted that the features upon which applicant relies (i.e., the widening of the channel region(s), source, drain, element isolation, and gate contacting regions) are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993).



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It is argued, at page 6 of the remarks, that "since the width of the gate electrode can be substantially larger than the gate insulation film...a proper resistance for the gate electrode can be obtained." However, once again it is noted that applicant relies on features (substantially wider) not recited in the claims. Further, the critical area, per the claims, is the area of the gate electrode in contact with the gate insulation film. To make this area larger, the very top of the gate insulation film (the part that provides a contact surface) must be widened as well. The claims, as amended, merely require that some upper part of the gate insulation film be smaller in area than the area defined by the gate electrode/gate insulating film interface. Krivokapic et al. clearly meets this limitation, as can be seen from figure 20.

### ***Conclusion***

5. THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, THIS ACTION IS MADE FINAL. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the

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shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thomas L Dickey whose telephone number is 703-308-0980. The examiner can normally be reached on Monday through Thursday 8 AM to 6 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nathan Flynn can be reached on (703) 308-6601. The fax phone numbers for the organization where this application or proceeding is assigned are 703-308-7722 for regular communications and 703-872-9319 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 306-3431.

tld  
04/2002

  
Minh Loan Tran  
Primary Examiner